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BIOGRAPHY.

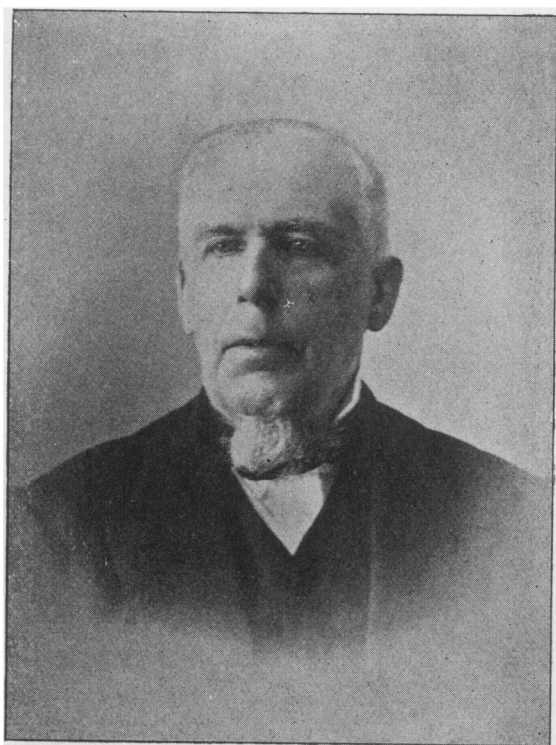
DANIEL KIRKWOOD.

BY ROBERT J. ALEY, A. M., PROFESSOR OF MATHEMATICS IN THE INDIANA STATE
UNIVERSITY, BLOOMINGTON, INDIANA.

“His is truly a great name in science, with a world wide renown.” So wrote Professor P. Piazzzi Smyth, Astronomer Royal for Scotland in 1885. He who knows Dr. Kirkwood either personally or through his contributions to science, gladly gives assent to the Astronomer Royal's eulogy. The Indiana University, whose faculty he for so many years honored, has just named in his honor the large handsome new building now being constructed. This is her first building named after a living man.

Daniel Kirkwood is of Scotch Irish descent, his grandfather coming from Ireland and settling in Delaware in 1771. His parents were both born in this country. He was born in Hartford County, Maryland, September 27, 1814. He had only the usual advantages of a farmer boy in those days. Not particularly liking the life of a farmer he turned his attention to teaching and at the age of 19, he took charge of a country school at Hopewell, York County, Pennsylvania. In this school a young man desired to study Algebra. A copy of Bonnycastle was secured and together teacher and student explored its mysteries. This year's work aroused his interest in mathematics and no doubt had much to do in shaping his future.

In 1834 he entered York County Academy at York, Pennsylvania. His work here must have been of a superior kind, for in 1838 he was elected first assistant and mathematical instructor. He held this position until 1843 when he became principal of the Lancaster, Pennsylvania High School. While here he married Miss Sarah A. McNair of Newton, Pennsylvania. In 1851 he became professor of mathematics in Delaware College. In 1854 he was pro-



DANIEL KIRKWOOD.

moted to its presidency. At the expiration of two years he resigned to accept the chair of mathematics in Indiana University. With the exception of one year 1866-7 when he was professor of mathematics in Washington and Jefferson College, he held the chair of mathematics in Indiana University until 1886, when he resigned on account of failing health. He then became Emeritus Professor, a position which he still holds.

In 1889 he removed to Riverside, California. At the opening of Leland Stanford Jr. University he was appointed Non Resident Lecturer on Astronomy. He is now in his eightieth year and is passing his declining years pleasantly with a favorite nephew on an orange ranch in Southern California.

His natural bent for mathematics found its activity in application to astronomical problems. His whole life has been devoted to theoretical and mathematical astronomy. Never having access to an observatory himself he has been content to take the observations of others and from them work out those broad generalizations and those specific explanations that have been of such great value to astronomical science. In his case there is scarcely a doubt but that the lack of an observatory has been a real benefit to Astronomy. His peculiar strength lay in the line of theoretical astronomy and in this line his work has been done. An observatory might have turned him aside. He is a member of the American Philosophical Society and of the American Association for the Advancement of Science. To these two societies many of his most valuable papers were first read.

In 1849 he made public what is now known in Astronomical literature as "Kirkwood's Law." This at once gave him prominence. Because of this discovery, Proctor has named him the "Kepler of America." As this law has not yet found its way into many popular astronomies it is quoted here entire:

KIRKWOOD'S LAW.

"Let P be the point of equal attraction between any planet and the one next interior, the two being in conjunction; P' that between the same and the one next exterior.

Let also D = the sum of the distance of the points P, P' from the orbit of the planet; which I shall call the diameter of the sphere of the planet's attraction;

D' = the diameter of any other planet's sphere of attraction found in like manner;

n = the number of sidereal rotations performed by the former during one sidereal revolution around the sun;

n' = the number performed by the latter; then it will be found that,

$$n^2 : n'^2 :: D^3 : D'^3; \text{ or } n = n' \left(\frac{D}{D'} \right)^{\frac{2}{3}}.$$

That is, the square of the number of rotations made by a planet during one revolution around the sun, is proportional to the cube of the diameter of its sphere of attraction; or, $\frac{n}{D^{\frac{2}{3}}}$ is a constant quantity for all the planets of the Solar System."

This law was subjected to a rigid mathematical examination by Sears C. Walker in the *American Journal of Science*, New Series, vol. X. pp. 19-26. Dr. B. A. Gould, Jr. in the same number of the *American Journal of Science* shows how the Law supports the Nebular Hypothesis.

The Law as originally stated has been subjected to slight modifications by the author in recent years. It has never been mathematically demonstrated. It is yet in the same condition that Kepler's Laws were when they were first announced.

Dr. Kirkwood has given much attention and study to the subject of Comets and Meteors. In this field he is an authority. His two books, "Meteoric Astronomy" 1867, and "Comets and Meteors" 1873 are both well known. Miss Clerke in her *History of Astronomy*, p. 381, in speaking of Comets and Meteors says:

"Professor Kirkwood, however, by a luminous intuition, penetrated the secret so far as it has been yet made known. In an article published, in the *Danville Quarterly Review* for December 1861, he argued from the observed division of Biela, and other less noted instances of the same kind, that the sun exercises a "divellent influence" on the nuclei of comets, which may be presumed to continue its action until their corporate existence (so to speak) ends in complete pulverization. "May not," he continued, "our periodic meteors be the debris of ancient, but now disintegrated comets, whose matter has become distributed round their orbits."

Many of his contributions to current scientific literature relate to comets and meteors. His study on these subjects has done much to verify and slightly modify the Nebular Hypothesis.

When about fifty asteroids were known Dr. Kirkwood announced the theory that in those spaces were simple commensurability of motion with that of Jupiter occurs, there must be gaps in the asteroid zone. The theory was based on mathematical and physical facts. It was at once received with favor and in 1870 Proctor spoke of it in the highest terms. At present the large number of known asteroids goes far to verify the theory. There is scarcely a doubt that the physical facts underlying the law of commensurability have in the main regulated the distribution of the asteroids. Only two or three exceptions, the most prominent of which is the minor planet Menippe, are yet known. Dr. Kirkwood applied the same theory to the rings of Saturn and found that the breaks in the rings occurred just where commensurability of motion with Saturn's satellites would indicate they should be. Dr. Meyer of Geneva in a work on Saturn's Rings has worked out in detail the theory suggested by Kirkwood. Kirkwood calls attention to this in a communication to the American Philosophical Society, and makes clear his claim to priority. He also expresses great gratification that so distinguished an authority as Dr. Meyer should verify his theory.

His life has been a very busy one. Its fifty active years have been spent in teaching, and his scientific contributions have been made in addition to the duties of the school room, which were never in the least slighted. The great

bulk of his writings appear in the Proceedings of the American Philosophical Society. The *Sidereal Messenger* and the *American Journal of Science and Arts*. But as his bibliography will show, many other scientific and literary journals have been honored by contributions from his pen.

In his adopted State, Indiana, he is held in the highest esteem. The state Teachers' Association in 1859 elected him mathematical editor of the *Indiana School Journal*. The mathematical department of the *Journal* under his care was very strong. Besides giving it his careful direction he contributed many notes, comments and solutions. After nearly four year's service he resigned because of lack of time to give to it the attention demanded.

For perhaps fifteen years he was a regular contributor to "The Journal" of Indianapolis, a leading daily of the State. All the current astronomical events were duly written up. Many of the articles appeared unsigned on the editorial page, while many more appeared on the literary page duly signed. It is safe to say that while Daniel Kirkwood corresponded for the *Journal* no daily in the country surpassed it in the trustworthiness of its astronomical statements.

Prior to 1885 he was employed by the Appleton's to write the articles on *Astronomical Progress* for their *Annual Encyclopaedia*. These articles, as indeed is true of all his writings, are characterized by brevity, clearness and accuracy. Few men have possessed in a higher degree than he the ability to say so much in so few words. His most remarkable theories and conclusions have been conveyed to the public in articles remarkable both for their simplicity and brevity.

To write the plain truth about the personal character of Daniel Kirkwood is to write such an eulogy as most men give to their ideal hero. By his pupils he is universally loved. The admiration, almost reverence they have for him is admirably illustrated in this statement made by one of his students years ago, "When I die I want to go where Dr. Kirkwood goes." The personal charm of his character is manifest to those who know him only through science and correspondence. Some years ago when Proctor was making a lecture tour of the United States, he lectured in Indianapolis. After the lecture he was approached by a delegation from Greencastle requesting him to lecture there the next evening. He said, "no I cannot do so. I came from England to America to see Daniel Kirkwood. To morrow is my opportunity and I am going to Bloomington to see him."

The writer well remembers his first visit to Bloomington. He went into a barber shop and as it was a rainy day there was quite a crowd of loafers, white and black, professional men and day laborers. By chance the conversation turned to men. Every man present found his ideal in Daniel Kirkwood. No man ever received a higher tribute of praise. His life is so simple, so pure, and so true that the student, the philosopher and the common man can all find in him the ideal. So sweet and well tempered is his disposition that if he has or ever had an enemy no one knows it.

In religion he is a Presbyterian. Although a strong believer in the

Westminster Confession, his broad mind has charity for all who try in any way to follow in the footsteps of the blessed Jesus. His study of the stars has but strengthened his belief in God. To his mind, with its faith strengthened by an almost infinite grasp of the mightiest works of God, unbelief is impossible and he can hardly understand how honest unbelief can exist in another. Some years ago he gave a beautiful demonstration before a class. A student asked "is that always true?" "yes" said he, "as true as that there is a God in Heaven." "But," said the student, "what would you say to him who does not believe in God?" Straightening up to his full height, and with glittering eye he said, "I would try to keep my temper and get away as quickly as possible."

As a teacher he has come in contact with thousands of young men and women. He is not a believer in educational forcing and so the student who did not wish to learn could get through his work without very great effort; but the earnest student found in him a help and an inspiration. Although gifted with unusual mathematical ability he appreciates the difficulties that confront the young learner. His remarkable ability in explaining a difficulty by a few words gave his classes unbounded confidence in him. Neatness and accuracy in thought and expression he constantly demanded. But perhaps the greatest lesson he taught was that of his simple, sweet life. A well known alumnus of Indiana University said in a public lecture a few years ago, "The specific lessons of the class room, the formulae and theorems of my college course have been forgotten, but there is one thing worth more than all else that will ever abide, the lesson in true life given me by my daily contact with the noble astronomer, Daniel Kirkwood."

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Reminiscences of William Lenhart, Esq.....	Vol. II.

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 Periodicity of Certain Planetary Rings.....Vol. XI.
 On the Formation and Primitive Structure of the Solar
 System.....Vol. XII.
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 of Jupiter, Saturn, Uranus and Neptune.....Vol. XII.
 On the Meteors of January 2nd.....Vol. XIII.
 On Eight Meteoric Fireballs Seen in the U. S. From July '76
 to Feb. '77.....Vol. XVI.
 Ages of the Sun and Fixed Stars.....Vol. XVI.
 Aerolitic Epoch of Nov. 12-13.....Vol. XVII.
 Cosmogony of LaPlace.....XVIII.

Meteoric Fireballs Seen in U. S. During the Year Ending March 31, 1879.....	Vol. XVIII.
On the Origin of Planets.....	Vol. XIX.
The Zone of Asteroids and the Rings of Saturn.....	Vol. XXI.
The Limit of Stability of Nebulous Planets.....	Vol. XXI.
The Comet of 1866 and the Meteors of Nov. 14.....	Vol. XXII.
Relation of Aerolites to Shooting Stars.....	Vol. XXIV.
Biela's Comet and the Large Meteors of Nov. 27-30, Vol. XXIV.	
On the Possible Existence of Fireballs and the Meteors in the Stream of the Bielids	Vol. XXVII.
On the Inclinations of the Asteroids.....	Vol. XXVII.
The Mutual Relations Between the Orbits of Certain Asteroids.....	Vol. XXX.

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On Certain Analogies in the Solar System.....	Vol. XIV.
On Aurora of 1859.....	Vol. XXVIII.
On the Nebular Hypothesis.....	Vol. XXX.
November Meteors, 1860.....	Vol. XXXI.
Orbits of Binary Stars.....	Vol. XXXVII.
Harmonies of the Solar System.....	Vol. XXXVIII.
Planetary Distances.....	Vol. XXXIX.
Meteorite of July 1867.....	Vol. XLIV.
Comets of 1812 and 1846.....	Vol. XLVIII.
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Meteors of April 30—May 1st	Vol. IV.
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Meteors of November 14th.....	Vol. VI.
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November Meteors.....	Vol. XV.
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Origin of Comets.....	Vol. XXXIII.
The Asteroids.....	Vol. XXXV.

SIDEREAL MESSENGER.

Now Astronomy and Astro-Physics.	
The August Meteors.....	Vol. I.

A Large Meteor.....	Vol. II.
Note on a Meteor.....	Vol. II.
The Limits of Stability of the Solar System.....	Vol. IV.
Recently Discovered Asteroids.....	Vol. IV.
The Comet of 1866 and the Meteors of Nov. 14.....	Vol. IV.
Commensurability of Motions.....	Vol. IV.
The Comets of 1812-I. and 1846-IV.....	Vol. V.
The Biela Meteors.....	Vol. V.
Note on the Origin of Comets.....	Vol. VI.
Distribution of the Minor Planets.....	Vol. VI.
The Eccentricities and Inclinations of the Asteroidal Orbits.....	Vol. VI.
The Relation of Aerolites to Shooting-Stars.....	Vol. VI.
Notes on the Progress of Astronomy.....	Vol. VII.
The Relation of the Short Period Comets to the Zone of Asteroids.....	Vol. VII.
On the Inclination of Asteroids.....	Vol. VII.
Note on 279th Asteroid.....	Vol. VIII.
On the Inclination of the Asteroid.....	Vol. VIII.
The Origin of Gaps in the Zone of Asteroids.....	Vol. X.
Groups of Asteroids.....	Vol. XI.
The Development of the Solar System.....	Vol. XII.
Holme's Comet; Its Probable Relation to the Zone of Asteroids.....	Vol. XII.
The Leonids or Meteors of Nov. 13.....	Vol. XII.
Relations Between the Mean Motions of Jupiter, Saturn, and Certain Minor Planets.....	Vol. XII.
Tuttle's Comet and the Perseids or August Meteors.....	Vol. XII.
PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.	
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Distribution of the Asteroids.....	1875.
Temporary Stars.....	1884.
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The Meteors of Nov. 12-14, 1867.....	Vol. 28.
The Meteors of Nov. 13-14, 1868.....	Vol. 29.
On the Nebular Hypothesis and the Approximate Commen- surability of the Planetary Periods of.....	Vol. 29.
Relations Between the Motions of Some of the Minor Planets...	Vol. 35.

THE LITERARY RECORD.

Distances and Magnitudes of the Fixed Stars.....	Vol. I.
The Asteroids.....	Vol. II.
The Meteors of July 13th, 1846.....	Vol. II.
Astronomical Discoveries.....	Vol. III.
On the Probable Existence of Undiscovered Planets.....	Vol. III.

THE NEW ENGLANDER

The New Planets.....	Vol. XVIII.
Solar Phenomena.....	Vol. XIX.

OUR MONTHLY.

Sidereal Systems.....	Vol. III.
Changes in Celestial Scenery.....	Vol. IV.
Total Eclipses of the Sun.....	Vol. IV.

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NON-EUCLIDEAN GEOMETRY: HISTORICAL AND EXPOSITORY.

By GEORGE BRUCE HALSTED, A. M., (Princeton); Ph.D., (Johns Hopkins); Member of the London Mathematical Society; and Professor of Mathematics in the University of Texas, Austin, Texas.

CHAPTER SECOND.

THE FIRST TREATISE ON NON-EUCLIDEAN GEOMETRY.

[Continued from the April Number.]

Is it not surprising that a book so remarkable, that it will henceforth forever mark an epoch in human thought, should have been forgotten for more than a century and a half? The first treatise on Non-Euclidean Geometry, a